

Guide #2

Fuel Treatment and Continuing Management

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Introduction

Many factors contribute to fuel system problems, and Pecuniary, Inc. offers a wide range of Fuel Treatment Systems and products manufactured by AXI-International (formerly ALGAE-X[®]) and other recognized companies that address fuel storage problems ranging from large fuel storage systems down to the individual's problem with their boat, truck, or generator. The various systems offered differ somewhat as the installation dictates and the volume of stored fuel in tanks gets larger, but the process to treat and maintain fuel, with only a couple exceptions, are essentially the same. This Guide provides you with the recommended procedure for treating your fuel with any of the Fuel Treatment Systems and products that Pecuniary, Inc. distributes.

Know the Fuel You Receive

Diesel Fuel in most countries is controlled by standards, but some countries have terrible fuel. If you have a long-standing relationship with your fuel supplier, your confidence in that supplier is undoubtedly high. You have come to expect good fuel and you get it. But this by no means guarantees you will not have problems as many aspects of fuel transportation and storage is subject to unanticipated problems. Introduction of a small quantity of contaminated or degraded fuel into a storage tank can, with the passage of time, cause problems with the entire inventory of fuel. Management of stored fuel assumes the fuel was good to start with, but has degraded in route to you as a result of any one of many unforeseen circumstances or has degraded due to one of many unknown variables after it enters your tank.



If you have reason to question your source of fuel, the best first step is to maintain a separate quarantine tank of sufficient size to take on the fuel until you are sure the fuel meets your standards. It is very frustrating to find that a load of fuel has contaminated clean tanks and compromised good fuel. This is especially critical to large emergency power installations such as data centers, medical facilities, and first responder facilities. The quarantine tank should be emptied of any contaminants and water prior to tanking on a fresh load of fuel. Fuel deposited into the quarantine tank should be allowed to settle, allowing any water or contaminants to settle. Samples of fuel from the middle and bottom of tank should be taken and inspected. Cloudy fuel indicates that there is emulsified water in the fuel, and dark fuel shows that the fuel has been in storage too long before you received it and degradation of the fuel is already well underway. Bottom samples should not show particulates or sludge. Allow the sample to settle and determine if water is separating out of the fuel. If the fuel appears to have issues, the fuel should be polished and water removed prior to transfer into the main process tank, assuring the new load of fuel does not compromise the process tank.

If a quarantine tank is not feasible in your situation, steps can be taken to insert a filtration step between the fuel delivery equipment and your tank. Filters will need to be sized to the delivery rate, and the type of filtration should be considered. Use of water-block or coalescing filters remove water during the delivery process. Large volume deliveries can first be routed through a High Flow filtration vessel such as the [FV Series High-Flow Filtration Housings](#).

Where pre-filtering is not feasible, allow fuel to settle in the quarantine tank for several days after taking on fuel, allowing any suspended particulates and/or water droplets and emulsified water to settle and accumulate at the bottom of the tank. Use a measure stick with water finding paste ([Kolor Kut Water Finding Paste](#) is available at www.diesel-fuels.com) to determine if water is present. Spread the water finding paste on the lower several inches of the measure stick and insert the stick to the tank bottom. Remove the stick and inspect the paste. Paste that touches water will change color, showing how much water is in the bottom of the tank. You may also use the PVC pipe method outlined below.



Other steps to assure fuel quality, including determining if bacterial or fungal contamination is present, can likewise be performed at this time ([Liqui-Cult Fuel Test Kits](#) detect microbial growth in fluids, and are available at www.diesel-fuels.com). A simple test of the specific gravity of the fuel can be performed to assure fuel quality. More extensive tests may be performed, such as capturing samples from different levels within the tank and having those samples lab-tested to assure they meet standards.



If the load of is found to meet set standards, the transfer of the fuel to the process tanks can be completed. If water is present in the tank bottom, remove the water by pumping from the bottom of the tank. If the fuel appears degraded other contaminants are present (microbial, fungal, free water, emulsified water, etc.), the fuel can be treated by circulation of the fuel through a [mobil or portable Fuel Treatment System](#), through a dedicated [Wall Mounted System](#) or an [Automated Fuel Treatment System](#) prior to transferring the fuel to a process tank (to understand the differences between these systems, see [Guide #4 Determining what Fuel Treatment System is Right for You](#)).

Prior to transferring the fuel to the process tanks, it is a good idea to add [AXI Diesel Fuel Catalyst AFC-710](#) to the fuel. AFC-710 is a unique and powerful Tier 4 compliant broad-spectrum fuel additive concentrate for use in diesel, biofuels, gasoline, kerosene and heavy fuel oil (HFO). It will stabilize the fuel and preserves the integrity of stored fuel up to twelve months.

Remove any accumulated or residual water from the quarantine tank before taking on another load of fuel. The Fuel Treatment System may also be used periodically on the process tanks to assure continuing quality of the fuel.

Smaller installations cannot, of course, meet this protocol. Maintaining quality fuel in these cases can best be achieved by observing the following fuel management guidelines.

Solving Diesel Fuel Problems – Keeping Water out of Your Fuel Tank

There are several steps that can be performed periodically by every user of fuel, regardless of storage capability or volume of fuel usage, that would cost very little in personnel time and dollar outlay:

The Dos:

Keep Fuel Tanks Full. Air is drawn into fuel storage tanks as the fuel is drawn off and used. Also, when the temperature of the tank fluctuates, the changes cause the fuel to expand and contract, expelling and pulling in air through the vent. With the air, comes moisture. Moisture in the air inside the tank condenses on the sides of the storage tank and collects in the bottom of the tank providing a habitat for microbial contamination, also present in the air, to grow to the point where the symptoms of a contamination problem is evident (see [Guide #1](#) for a list of symptoms). The ongoing accumulation of water and the growth of the microbial contamination may take months or even a year to show itself. Keep fuel tanks filled to minimize the air that is drawn in by expansion and contraction of the fuel in the tank.

Test Tanks for Water. [Water Finding Paste](#) can be used on a dial rod, length of PVC pipe, or tank measuring

stick to determine how much water has accumulated in the bottom of a fuel storage tank.

Sample Tank Bottom. If a tank has a straight-line access to the bottom of the fuel tank from the fuel fill hole or through another inspection port, a length of PVC or similar material pipe, ½ inch in diameter, can be used like a soda straw to sample what is in the bottom of a tank. Cut the pipe to length to allow insertion of the pipe to the bottom while allowing your thumb to cover the exposed end of the pipe. With your thumb over the end, insert the pipe to the bottom of the tank, remove your thumb so what is at the very bottom will rush into the tube to the level of fuel in the tank. Again place your thumb over the end of the pipe and extract the pipe, maintaining the liquid and other materials inside the tube. Empty the tube into a clear 2-litre empty soda container placed inside a five gallon bucket (to catch any spillage). Perform this action several times and inspect the materials in the bottom of the plastic container. Any debris or water should be apparent.

Sample fuel. Use the same process as above using a ½ inch in diameter PVC pipe to take samples of fuel at different depths of the tank immediately after taking on a load of fuel. This time, however, put the fuel into glass mason jars or used clear plastic drink bottles. Inspect the fuel visually for hazy fuel, indicating water is in the fuel. Record your observation on tape on the jar for future reference. Allow the jar to sit for several hours to determine what water may separate and settle to the bottom. Note that any water present may have been stirred up from the bottom of your tank or may have been introduced from the fuel load taken on. Either way, the water should be removed.

For large tanks where the PVC tube method is not practical, the [AXI Tank Sampler](#) is available in 4 oz, 8 oz, and 16 oz sizes to capture a fuel sample. Suspended from a chain or cord, with a second trigger cord, a sample of fuel can be taken from any level within a fuel tank.



Removing Residual Water from Fuel Tanks. Although a large amount of water can be removed from a tank by using a pump, and moderate amounts may be removed by using the pipe-like-a-soda-straw process described above, small amounts, or “residual”, water is more difficult to remove. [The Water Eliminator](#) is a device that uses water absorbing crystals within a screen frame (the special crystals will absorb water, but not fuel). The device, which contains a weight, is inserted into the fuel tank and allowed to remain on the tank bottom, with a lanyard connected to the fuel cap to allow for easy retrieval. Inspect the device for water absorption at each fuel fill and remove if the crystals have swollen with water. Allow water to evaporate and reuse, although the device will degrade and should be disposed of after several uses or when the crystals appear dark. Available in 7 inch units for smaller tanks and 32 inch units for storage tanks of 1,000 gallons or larger.



The Don'ts:

Unintended Consequences. It is common for engines on equipment that is not in regular service (emergency power generators, equipment used seasonally, etc.) to be subject to periodic maintenance that includes starting the engine and allowing it to idle until it is up to operating temperature to circulate motor oil and assure components are operating up to standards. Fuel is heated in the process as it is pressurized and circulated through heated engine components. Many fuel systems circulate fuel that is not used in the combustion process back to the fuel tank, resulting in an increase in the temperature of the fuel in the tank, which in turn causes water formation from condensation. Keep fuel tanks filled to minimize the air that is drawn in by expansion and contraction of the fuel in the tank. Recognize that this common maintenance practice can result in water accumulation and periodic testing for water and removal is an important step in system maintenance.



Lab Analysis of Diesel Fuel – Testing the Fuel

Diesel fuel can be tested in a laboratory setting to determine such characteristics as viscosity, API Gravity, and other characteristics. Fuel Sample Test Kits are available for obtaining test results from a lab. In addition, [Liqui-Cult Fuel Test Kits](#) are available for determining if fuel has microbial or bacterial contamination.



Fuel Management Systems – A Three Part Process

Treating contaminated and degraded fuel is not a simple process. It is not as simple as emptying a bottle of magic elixir into your tank and the problem goes away. Fuel can be returned to a clear and bright condition, returning the fuel to a state that provides optimal combustion, efficient operation, and allowing fuel filters to provide hundreds of hours of uninterrupted service.

The Fuel Tank Cleaning Protocol has three components. First is the removal of water and debris from the tank bottom. This may need to be performed by a pump and involve disposal of the water, sludge and debris. But sometimes, this step can not be performed because of the nature of the tank installation, such as in a boat hull or motor vehicle. Extreme contaminations may require extreme steps to be taken in this step, but a mild contamination problem can skip this step if necessary. Second is the introduction of a fuel additive that prepares the tank and releases the critical contamination located on the bottom and sides of the tank and emulsifies the residual water up into the fuel for treatment. Third is a Fuel Tank Cleaning System that circulates the fuel out of the tank for treatment. The circulation process is critical to removing suspended particulates and residual water (microbial contamination habitat), returning the asphaltene components of the fuel back into suspension within the fuel (fuel polishing) reversing fuel degradation, circulating microbial contamination to stop the reproduction process and prevent future contamination, and removing emulsified water from the fuel with water absorptive filter media.



The AXI [Diesel Fuel Catalyst AFC-705](#) addresses the need to remove the residual water from the tank. This fuel additive is unique in that it is a fuel tank maintenance additive. There are many fuel additives in every parts store and truck stop, but these do not address the unique needs of maintaining the fuel tank. In addition, AFC-705 does not contain a biocide component as biocides will create solid debris from organic contamination, aggravating the problem. The AFC-705 works “hand-in-glove” with the Fuel Tank Cleaning System to make sure that, in the end, your fuel system is in peak condition.

AFC-705 is powerful. In a known contamination situation, use one (1) ounce of AFC-705 in twenty (20) gallons of fuel (one gallon treats 2,500 gallons). For periodic preventative maintenance programs, use one (1) ounce of AFC-705 in forty (40) gallons of fuel (one gallon treats 5,000 gallons).

- Dissolves tank sludge from the bottom, sides and baffles inside the tank.
- Dissolves the build-up of asphaltenes on the tank bottom up into the fuel for further treatment by the Fuel Management System.
- Residual free water will be emulsified into the fuel by AFC-705 for further treatment and removal by the Fuel Management System.

Always use AFC-705 with a full tank of fuel and always take steps before adding AFC-705 into the fuel to remove all free water that may have accumulated in the bottom of the tank. AFC-705 has components that emulsify water from the tank up into the fuel. This step is important as the emulsified water can then be removed by the Fuel Tank Cleaning unit. Excessive water will make the fuel hazy and put additional burden on the circulation process (this is why the first step above is to remove water and sludge before adding the AFC-705 if at all possible). If the water cannot be removed due to inability to route a PVC pipe or suction hose to the bottom of the tank, then the Fuel Tank Cleaning unit will be able to remove the emulsified water from the tank, but the process of circulating the fuel with the Fuel Tank Cleaning unit will take longer, requiring more operator time and more water-block filtering media will be required.

If you operate equipment that is equipped with engines designed to meet Tier 4 compliance mandates, AXI Diesel Fuel Catalyst AFC-710 is the product for you. Although AFC-710 does not contain the component that emulsifies the water into the fuel, it is an effective tank cleaning product that will stabilize your fuel, prevent sludge build-up, and eliminate the need for expensive and toxic biocides.

What is Fuel Polishing?

We have said that simply filtering the fuel does not address the core of the problem. The microbial (bacterial) contamination resides in the water, but when fuel is added to the tank and water is mixed with the fuel, the organic contamination spreads throughout the tank. The finest filter will not remove microbial contamination from the fuel stream. When a microbial contamination exists, even removing as much water as possible will not eliminate the contamination.

The [AXI Magnetic Fuel Conditioner](#) (“MFC”) is a patented unit that, when the fuel circulates around a strong magnet contained in an aluminum housing, performs two functions. The motion through a magnetic field makes the microbes inert so they do not reproduce, and the action also puts the asphaltene components back into solution. This action takes the dark, contaminated fuel and makes it clear and bright, returning the combustibility lost as a result of the fuel degradation. This is the essence of the term “Fuel Polishing”. All AXI Fuel Systems have an MFC as the central component to the System. If another circulation system is considered containing only a series of filters, it is not capable of Fuel Polishing. The MFC is at the core of diesel fuel polishing.

The Fuel Tank Cleaning Systems

There are a number of Fuel Tank Cleaning Systems that address different applications, fuel tank sizes, and particular needs of our customers. AXI offers a Fuel Tank Cleaning System that is right for you. All Systems fall into one of the following categories:

- [Portable \(Handheld\) Tank Cleaning \(“PTC”\) Systems](#)
- [Mobil Tank Cleaning \(“MTC”\) Cart Systems](#) or [High Capacity \(“HC”\) Pallet Mounted Tank Cleaning Systems](#)
- [Wall Mounted Tank Cleaning Systems](#) (installed systems dedicated to one or a few tanks)
- [Automated Enclosed Tank Cleaning Systems](#) (large installed systems)

All Fuel Management Systems operate substantially in the same manner. The systems differ only in their design capacity and whether they are used on a dedicated tank installation or are moved from tank to tank to perform their task. In addition to the basic systems, there are additional components available to enhance the operation of fuel systems, including [pre-filters](#) designed to remove particularly heavy contamination and [high-flow filtration](#) for bulk fuel distribution equipment.

See the [Guide #3: Inline Fuel Tank Cleaning](#) and [Guide #4: Determining What Fuel Treatment System is Right For You](#) to understand how the different AXI Fuel Tank Cleaning units are sized, configured and operated.

Maintaining Diesel Fuel For the Long Term

Combining a fuel system protocol that suits your particular needs, the AXI Diesel Fuel Catalyst AFC-705 or AFC-710, and the appropriate AXI Fuel Tank Cleaning System for your application will result in diesel fuel that will have an almost unlimited shelf life, maintain optimal fuel quality, provide for uninterrupted hours of reliable engine performance when you need it most, extend the life of engine components, and save you money.

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